HERPETOCULTURE NOTES

CROCODYLIA — CROCODILIANS

***CROCODYLUS INTERMEDIUS* (Orinoco Crocodile). HATCHING SYNCHRONY.** The Orinoco Crocodile is critically endangered throughout its range (https://www.iucnredlist.org/species/5661/3044743. Accessed 20 July 2020). In Colombia, Palmarito Foundation bred this species from 2012 to 2020. Eggs were collected at Wisirare Biopark (4.910397°N, 71.433817°W, WGS 84; 139 m elev.), Orocué, Casanare, Colombia, as a part of a captive-breeding and release conservation program.

From 2012 to 2015, eggs were incubated indoors in an incubator room, and from 2017 to 2020, they were incubated outdoors. In both cases, a hole similar in size and depth to wild nests was dug into sand. Each clutch was buried with 50 cm of separation between them. In the incubator room, eggs were heated with infrared lamps and temperature was controlled with a thermostat programmed at 31°C. Outdoor clutch temperatures were not recorded or controlled and the sun was the only heat source.

At Wisirare, Orinoco Crocodiles nest once annually, usually from late December to mid-late January (time lapse of between 2–18 days). In the first four seasons all clutches hatched indoors in the same order in which they were laid (time lapse of between 4–16 days). However, in the reproductive seasons of 2017–2020 when eggs were outdoors, clutches hatched almost simultaneously (time lapse of between 0–2 days). We found differences ($t = 2.535$; $p = 0.02$; $\alpha = 0.05$) in incubation period from indoor (mean = 83.8 days; N = 14; SD = 2.9) to outdoor (mean = 88.5 days; N = 19; SD = 6.3).

Despite the environmental influence of temperature on incubation length, many reptilian embryos may alter their development and hatching time (Du. et al. 2011. PLoS ONE 6: e29027). Intra-nest hatching synchrony has been reported in several reptile species including snakes (Aubret et al. 2016. Sci. Rep. 6[23519]:1–5), sea turtles (Santos et. al. 2016. Proc. R. Soc. B 283:1–7) and freshwater turtles (McGlashan et al. 2012. Proc. R. Soc. B 279:1709–1715). Our data suggests hatching synchrony among *C. intermedius* eggs from independent nests incubated outdoors.

Moreover, there is evidence that some embryos are able to metabolically compensate and catch up to more advanced embryos (McGlashan et al., *op. cit.*; Aubret et al., *op. cit.*). In our case, despite the lack of synchronicity patterns described for crocodilians, the process seems to be a deceleration of the metabolic rates of the early embryos, as evidenced by increased incubation period (Fig. 1).

There are several reports of intra- and inter-specific communal nesting with different hypotheses suggested, but the lack of nesting sites with optimal conditions and the benefits of proximity among embryos are the most relevant (Radder and Shine. 2007. J. Anim. Ecol. 76:881–887). To our knowledge, there are no reports of communal nesting of wild Orinoco Crocodiles.

A variety of methods of communicating hatching synchronicity within nests have been proposed: the production of sound, the vibration of the egg, an increase in heart rate, and odors or carbon dioxide levels within the nest, among others (Webster et al. 2015. PLoS ONE 10: e0116345). Our findings show that synchronicity occurs among eggs not in physical contact with each other. Based on our observations, we hypothesize that the sand may be transmitting some form of signal among nests that is promoted by environmental factors not available in the indoor incubators, possibly related to the natural cycle of heating and cooling.

Intra-nest hatching synchronicity has previously been described for reptile species. However, to our knowledge, this is

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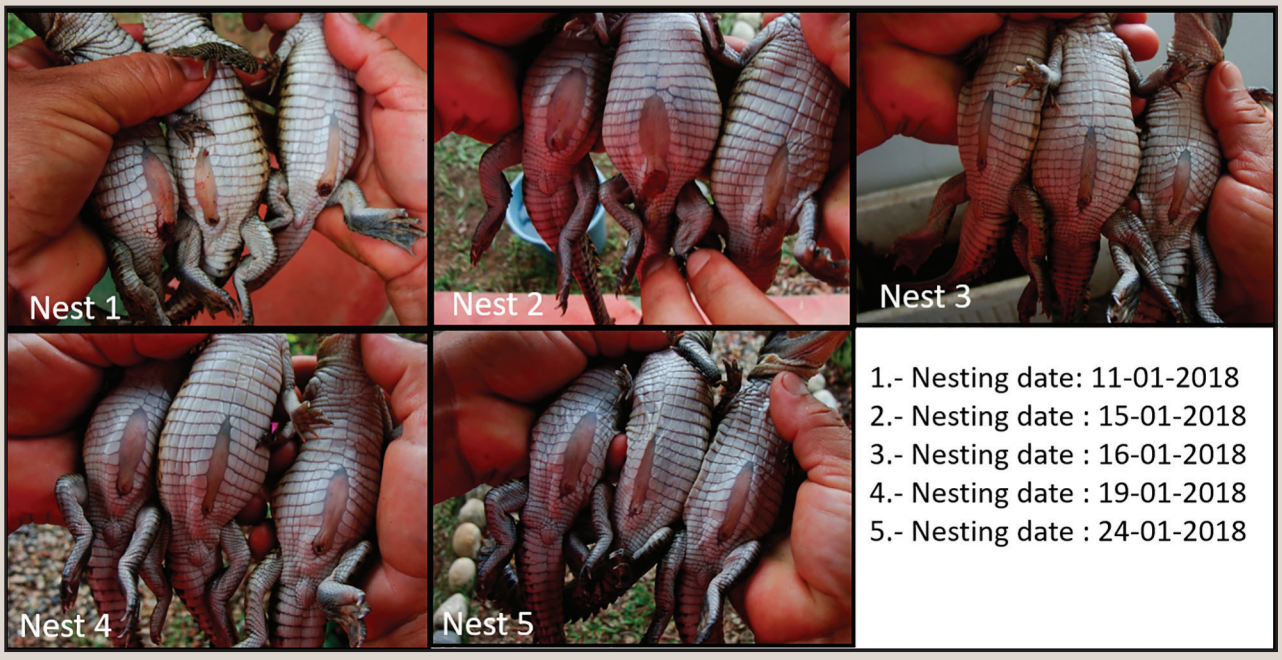

FIG. 1. Aspect of the umbilical scarring of 15 *Crocodylus intermedius* hatched in 2018, showing a very similar development stage. All hatched between 21–22 April, after 100, 96, 95, 93, and 88 incubation days, respectively.

the first report to document inter-nest hatching synchronicity where it is driven by nearby conspecific nests and not eggs within the same nest.

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SQUAMATA — LIZARDS

***HELODERMA CHARLESBOGERTI* (Guatemalan Beaded Lizard). MALE COMBAT.** *Heloderma charlesbogerti* is a critically endangered species currently restricted to the xeric Motagua Valley of eastern Guatemala whose ecology, especially reproductive ecology, remains relatively poorly known (Campbell and Vannini 1988. J. Herpetol. 22:457–468; Ariano-Sanchez 2015. Mesoamer. Herpetol. 2:64–74). Male-male combat behavior is well-documented in the other species of *Heloderma* (Beck 2005. The Biology of Gila Monsters and Beaded Lizards. University of California Press, Berkeley, California. 213 pp.), but has been reported only anecdotally in *H. charlesbogerti* (Owens 2006. Iguana 13:213–216). We here confirm the characteristic male-male combat ritual behavior, including the Body Twist and Body Arch postures, in *H. charlesbogerti* (Fig. 1). The behaviors observed appear to be very similar to those described in *H. suspectum* (Beck 2005, *op. cit.*, figs. 50, 52), *H. exasperatum* (Beck and Ramírez-Bautista 1991. J. Herpetol. 25:481–484), and *H. alvarezi* (Ramírez-Velázquez and Guichard-Romero 1989. Instituto de Historia Natural, Tuxtla Gutierrez, Mexico. 20 pp.). We conclude that this repertoire of ritualized combat behaviors is homologous among all species of *Heloderma*.

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SQUAMATA — SNAKES

***BOTHROPS FONSECAI* (Fonseca's Lancehead). REPRODUCTION.** *Bothrops fonsecai* is endemic to southeastern Brazil, occurring in northeastern São Paulo, southern Rio de Janeiro, and the southern limit of Minas Gerais. This snake is found in montane areas with mixed broadleaf and *Araucaria* pine forest (Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca, New York. 870 pp.), with an elevational range of ca. 400–1730 m, where the climate is characterized as high montane humid subtropical (Cwa) (Köppen-Geiger 1936. Köppen-Geiger climate classification. http://koeppen-geiger.vu-wien.ac.at/; 18 Oct 2019).

Despite knowledge gained in recent years regarding the reproductive biology of most Brazilian pitvipers, data on *B. fonsecai* are rare and reproductive information is restricted to a report of the number of embryos in a museum specimen (Sazima and Manzani 1998. Herpetol. Rev. 29:102–103), three captive litters reported by Duarte (2004. Herpetol. Rev. 35:175–176), the growth rate of a captive litter (Stuginski et al. 2017. South Am.

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FIG. 1. Two adult male Guatemalan Beaded Lizards (*Heloderma charlesbogerti*) engaged in typical combat behaviors, including the Body Arch (upper) and Body Twist postures. The bout was recorded in an outdoor area at Zoo Atlanta in July 2006. The individuals were introduced into the arena and no female was present.

FIG. 1. The female *Bothrops fonsecai* from Campos do Jordão – SP.